taking rank in the achievement of its highest aim—the enlargement of knowledge—there are last which shall be first and there are first which shall be last.

WILLIAM TRELEASE

THE BOTANIC GARDEN AS A FIELD MUSEUM OF AGRICULTURE

A FULLY equipped botanic garden serves more or less strongly a variety of useful purposes. To the public at large its chief function may appear to be that of a park or amusement ground where the dweller in flats may find, amid the fresh beauties of a productive soil, rest and refreshment for his soul, wearied by the daily dash over a city's well fertilized but unproductive pavement, and where the nurse-maid may sit reposefully on a shaded bench and give her charge a needed airing without fear of death by passing automobiles or beer wagons. To one interested in plants for their own sake, the botanic garden often means a place where may be found growing in conservatories or in the open rare plants of native and foreign origin—strange types that travelers tell us of in their wonder books—tree ferns, palms and exotic orchids. In European gardens American trees may be most strikingly present, while in American gardens it is the European trees that catch our eyes. The botanic garden is not, however, merely a species of plant circus that the curious may enter with the expectation of being surprised at oddities in nature and horticulture. It is primarily an attempt to represent the different types of vegetation of the world. In so doing, however, the native and agricultural flora is generally neglected on the perhaps not unnatural ground of its familiarity.

It is not in my province to discuss the various departments and aims of a modern botanic garden. I wish to speak as a teacher chiefly of the economic section already in botanic gardens, and to make some suggestions for its further development.

A systematically arranged and well-labeled botanic garden may be called a dictionary of living plants. You look up the family, the genus or the species and you find the meaning in the growing specimens or you find the known plant, and the label gives you its name and classification. Plants are not excluded from the subject-matter of the young child's continual search for the names of things. It is the fear of his frightful question, "What is it?" that has been the end of many a teacher's attempt to give simplified botany or nature study in the lower schools. To a teacher, if a botanic garden is to serve as a plant dictionary, it should be built on the type of a school or pocket dictionary. Botanic gardens are perhaps too often on the plan of those dictionaries of rarer words that have several times been published. In such a dictionary, says the author, it is needless to give common words familiar to all, as house, church and the like. Only those less familiar words, then, need be included which are at all likely to give trouble to a reading public such as pragmatism, esoteric and the like. A botanic dictionary on this plan might be expected to throw out such simple words as root, leaf and bud; but for the sake of the beginner who may stand abashed at the tangled mass of Greek and Latin roots that confront him in his pathway up the steep ascent of botanic knowledge, explicit definition might be expected of such words as "the law of priority," heterotypic division, and of the recent verbal immigrants of Greek origin not yet out of the quarantine of public opinion. Few of these dictionaries of rarer words are actually in use, for practise has shown that on the whole it is the common

words which are most often looked up in a dictionary. I do not have to remind the members of the section that at the Washington meeting in 1903, a committee was appointed to define the simple word "bud," and their difficulties apparently have been so great as to prevent them reaching a unanimous conclusion, since no report of this committee has been recorded.

In the Connecticut Agricultural College an attempt has been made to establish a garden largely on the plan of the pocket dictionary and a concrete description of what has been accomplished and what has been planned for this garden, may perhaps be the best method of bringing before the section what I have to say on the subject assigned me.

The public for which this garden has been planned is composed, first of regular students in the agricultural college, secondly of students in the summer school who are for the most part teachers throughout the state, and thirdly of visitors who are more or less interested in agriculture.

One section is devoted to school gardens, which are planted and kept in condition by school children of the neighborhood, and which serve as examples to the members of the summer school class in school gardening.

The largest division is the systematic section. In it are grown, arranged according to their family relationships, in full plots 9×5 feet in size or in half plots, all the chief species of agricultural importance in the state. So far as conditions will allow, the different plants are grown in the same way in which they are cultivated as farm or garden crops, and this section might well, therefore, be called a "crop garden." The familiar weeds, however, and some of the commoner wild plants are included in their proper order along with the economic forms. The Solanaceæ may serve as an example of the arrangement of one of the families. A plot of cherry tomato heads the row and with its small berry of two carpels shows the primitive condition of fruit. This is followed by varieties to show the modifications in the fruit brought about through cultivation in size, shape, color, texture of coat and number of carpels. In the row are also represented varieties of egg plant, peppers, potato, black nightshade and its more cultivated, though morganatic sisters—the garden huckleberry and wonderberry, as well as bitter sweet; petunias—single and the derived double-flowered form; tobacco; jimson weed, and matrimony vine. In a similar fashion the Leguminosæ, Gramineæ, the Cruciferæ and the more important genera are represented by native and cultivated forms.

The question which decides the admission of a native form is not, "Is it rare?" but "Is it common?" Perhaps the rarest flowers in the garden are those that are seen on such common biennials as cabbage, beets and parsnips which are planted the second year and allowed to show their systematic position by their flowers and fruit. The commoner ornamental plants are not neglected. Among the Compositæ, for example, dahlias, sunflowers and golden glow will be found alongside of lettuce and chicory, and among the Liliaceæ day lilies are found as well as leeks and onions. It is a continual source of wonder to the visiting agriculturalist to see in a botanic garden the dandelion lying down by the side of the lamb's quarters, and both led to live within bounds a life of unobnoxious cultivation. These weeds, as also the pig-weed and "pusley" scorned by the farmer, are known to every boy with the hoe, yet experience shows that their names are often confused. The very commonness of the dandelion makes it all the better as a type to head the row of the composite family.

Edible fruits are left to ripen on the

plants, and seem to have an educational value in that they attract students to the garden, where they may unconsciously have botanical knowledge thrust upon them. Certain it is that the freshmen who made voluntary investigation of the Cucurbitaceæ this last fall have come to appreciate the distinguishing characters of some members of the order—if one can judge by the number of citrons that were found opened by mistake for watermelons.

Where possible the primitive wild form is grown to show the improvement which has been brought about under cultivation. Thus, seed has been obtained of the wild tobacco (*Nicotiana rustica*) of *Triticum dicoccoides,* recently discovered in Palestine, and considered the source of emmer wheat; vines of native grapes and of *Vitis vinifera* show the sources from which our cultivated varieties have been compounded.

A third division is devoted to pathology. A few of the great groups of parasitic fungi may be represented, such as corn smut, wheat rust, with its alternate form on barberry, black knot of cherry, etc. A variety of bean susceptible to anthracnose will be grown in a plot adjacent to an immune variety, and a striking demonstration of the value of immune races may be expected. Plots can be sown with a mixture of grain and weed seeds and the effect of spraying with iron salts upon the competing plants be shown. The "calico" or mosaic disease of tobacco is a convenient type to illustrate a disease which is transmitted by inoculation, but which is apparently not caused by any living organism. Every other plant touched in a row with an infected leaf will contract the disease, and will form a sharp contrast to the uninoculated individuals left as controls. Non-infectious chlorosis of leaves and chlorosis through grafting may be better illustrated in shrubby forms.

A fourth section of the garden contains specimens to illustrate the laws of variation and heredity. Variations are the building stones out of which the plant-breeder forms his new "creations," and as such should be well classified. Variation in vigor of growth or in qualities of fruit may be due to inherent characters in the germ, which are more or less hereditary and therefore capable of transmission, or on the other hand they may be the response of the plants to recognizable differences in their environment. In the latter group would come the increased growth due to an increase of available food supply. For an illustration there may be grown plots of tobacco in poorly and richly manured soil to show the effect of abundance and lack of food in the substratum. The contrast between the growth of corn sown separately in hills, and the same plant sown thickly in drills, will show the effect of lack of food brought about by competition. In practise tobacco seed is blown, the light which produce small plants being rejected and the heavier reserved for sowing. Plots of tobacco from heavy and light seed, respectively, may be used to show the variation in adult plants due to the differing amount of storage food in the seed.

Fluctuating variations about a mean may be shown by sowing seeds from a single parent and comparing the offspring in respect to a single character. Plants can be grown to show in how far a selection of these fluctuations may be able to change the characters of a given plant. Indian corn furnishes a good example, since in addition to changes in the percentage content of protein, fat and starch in the grain, other clearly defined characters, such as the number, size and position of the ears on the plant, and the number of grains to the ear, have been shown to be markedly influenced by such selection.

Ever-sporting varieties may be illustrated by such races as the five-leaved clover of de Vries and his fasciated teasel. The theory of mutation can not be better illustrated than by the classical example of Lamarck's evening primrose with some of its most striking mutants.

Hybridization, as one of the most important means of effecting changes in combination of plant characters, demands a prominent consideration in the section of the garden under discussion. Mendel's law can perhaps best be shown by hybrids between white- and scarlet-flowered races of a free-blooming species like the scarlet runner bean in which the color characters are evident in vegetative as well as in floral parts, and the assumption of color factors is not necessary to explain the color relations of the offspring. If suitable examples can be obtained, blend and mosaic hybrids might also be illustrated.

Due to hybridization and other causes, the sexually formed seed can not be depended upon to reproduce the characters of the parents without change. Vegetative means of reproduction such as cuttings, since they merely increase the individual plant, do, however, reproduce individual characters. Sowings from seeds and roots respectively, from a single plant of some modern type of dahlia would show the truth of the saying, that cuttings come true, but seedlings do not.

It has been the writer's practise to have each student choose some single plant for personal investigation to find out from the plant itself as much as possible without unfavorable prejudice from literature. The amount of work has been largely voluntary and a reasonable proportion of the students have responded to the suggestions offered them for this elementary research work. A portion of the garden is reserved for carrying out cultures and experiments, which the students themselves may suggest, in connection with their plants under investigation.

The special type of botanic garden which has thus been outlined by specific examples is the outgrowth of the needs of a teaching botanist in an agricultural institution. It has furnished material for demonstration purposes, for laboratory exercises and for field observations. Its systematic section being built on the plan of the pocket dictionary with the most used forms represented has been considered as forming a not unnatural basis of a student's list of recognizable plants, and accordingly ability to identify the species grown in the garden has been expected of students taking botany.

Though the chief function of the agricultural botanic garden may be considered as being instructional for special courses, it should prove of interest to students outside their classes and to a visiting public. It may, therefore, be not inappropriately termed a field museum of agriculture.

A. F. Blakeslee

THE PSYCHOLOGY OF SOCIAL CONSCIOUSNESS IMPLIED IN INSTRUCTION[1]

I have been asked to present the social situation in the school as the subject of a possible scientific study and control.

The same situation among primitive people is scientifically studied by the sociologist (folk-psychologist). He notes two methods in the process of primitive education. The first is generally described as that of play and imitation. The impulses of the children find their expression in play, and play describes the attitude of the child's consciousness. Imitation defines the form of unconscious social control

[1] Read before Section L—Education. American Association for the Advancement of Science, Boston, December, 1909.